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New findings out on brain networks in children at risk for mental disorders

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Attention deficits are central to psychiatric disorders such as schizophrenia or bipolar disorder, and are thought to precede the presentation of the illnesses. A new study led by Wayne State University School of Medicine researcher Vaibhav Diwadkar, Ph.D. suggests that the brain network interactions between regions that support attention are dysfunctional in children and adolescents at genetic risk for developing schizophrenia and bipolar disorder.

"The brain network mechanisms that mediate these deficits are poorly understood, and have rarely been tackled using complex image analytic methods that focus on how brain regions communicate," said Diwadkar, associate professor of psychiatry and behavioral neurosciences and co-director of the department's Brain Imaging Research Division

The desire to understand dysfunctional brain mechanisms motivated Diwadkar and his team of colleagues and WSU medical students in the study titled, "Dysfunction and dysconnection in cortical-striatal networks during sustained attention: genetic risk for schizophrenia or bipolar disorder and its impact on brain network function," featured in the May issue of *Frontiers in Psychiatry*.

The study is clinically significant because the estimated lifetime incidence of schizophrenia or bipolar disorder in the groups studied is approximately 10-20 times what is generally observed. "We believe that genetic risk may confer vulnerability for dysfunctional brain network communication. This abnormal network communication in turn might

amplify risk for psychiatric illnesses. By identifying markers of network dysfunction we believe we can elucidate these mechanisms of risk. This knowledge may in turn increase focus on possible premeditative intervention strategies," Diwadkar said.

The researchers identified dysfunctional brain mechanisms of sustained attention using functional Magnetic Resonance Imaging data and complex modeling of fMRI signals. Data were collected in 46 children and adolescents ages 8 to 20, half at genetic risk for schizophrenia or bipolar disorder by virtue of having one or both parents with either illness. During the 20-minute fMRI, participants completed a sustained attention task, adapted to engage specific brain regions.

The researchers induced variations in the degree of demand on these brain regions – a method of assessing how genetic risk might impair the brain's ability to respond to attention challenges – by varying task difficulty. Increased attention demand led to increased engagement in the typical control group. The genetically at-risk group did not respond the same. Instead, interactions between the dorsal anterior cingulate, a principal control region in the brain, and the basal ganglia were highly dysfunctional in that group, suggesting impaired communication between specific brain networks.

The study indicates that brain networks supporting basic psychological functions such as attention do not communicate appropriately in young individuals at genetic risk for illnesses such as schizophrenia or bipolar disorder.

"Genetics and neurodevelopment are inextricably linked. How psychiatric illnesses emerge from their combination is a central question in medicine. Analytic tools developed in the last few years offer the promise of answers at the level of how these processes impact brain network communication," Diwadkar said.